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IDENTIFICATION OF MOST SUCCESSFUL EDUCATIONAL PROGRAMS AND THEIR CHARACTERISTICS

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Most successful vocational education programs are identified in sixteen community colleges through the use of the Delphi method. The design provided for a reliability check on the Delphi technique through the use of two independent Delphi panels on each campus. Hard data on 36 "most successful" and 36 "other" programs on 12 campuses were analyzed as a further check on the panel results. The reliability of Delphi panels was established. Discriminant analysis correctly classified an impressive number of the programs identified by the Delphi technique. The identifying characteristics of successful programs span the areas of student, curriculum, instruction, administration, and advisory committee. The educational use of the Delphi method is discussed.

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I. Introduction

Often it is difficult to judge educational programs in terms of relative success. This may be due to the unwillingness or inability of knowledgeable administrators to express unbiased and independent judgments for one reason or another, or because of the absence of an adequate model against which to measure success, or because of a lack of reliable information. With this kind of administrative problem in mind, the Northern California Research Group* adapted and developed the Delphi technique for pooling judgments in a way that made possible the reliable identification of successful community college programs (6). This paper presents a method for identifying "most successful" programs in an educational setting, examines the reliability of the method, and then uses the criterion "most successful" to identify easily-measured program characteristics which, in turn, are shown to differentiate successful programs from other programs.

Informed peer opinion has been studied over a long period of time in attempts to harness its potential for administrative use. Shortly after World War II peer opinion of coworker or "buddy" leadership quality was shown to generate

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* The Northern California Research Group is an informal association of some 30 community colleges. Its purpose is to encourage cooperative research and to exchange information on research projects and innovative programs. During 1971-72 Mr. Walter Brooks of Shasta College served as chairman of the Group and greatly influenced the conceptualization, design, and data collection which resulted in this study.

criteria which were as effective as ratings of superiors, instructors, or classroom grades when used to predict future performance in officer candidate school (7). In the mid-1950's peer opinion about the "reputation for being well administered" was also shown to generate criteria that were useful in predicting the quality of administration in college departments (4). During the 1960's other studies were made on the effects of group influence on creativity during "brain-storming" sessions and on the influence of majority or authority opinion on individual conformity (2,5). It was during this period that studies commissioned by the RAND Corporation systematized the collection and use of expert opinion in order to generate an informed consensus about unresolvable problems. The objective was to generate a consensus that would be uncontaminated by "specious persuasion," the effects of rank or charisma, the difficulty of abandoning a publicly expressed opinion, and the pressures exerted by majority opinion in a group (1,3). The process that resulted was called the Delphi method, presumably after the oracle of ancient Delphi.

The Delphi method is a technique for pooling expert opinion in situations where no objective criteria are available. The method is simple: Participants, who are generally experts, are asked to give an opinion on some unresolvable topic such as "In what year will science develop a cure for cancer?," or "When will World War III begin?," or (conceivably) "How many angels can stand on the head of a pin?." The opinion is given

anonymously and without benefit of consultation with other participants. Statements are collected and combined and, without any acknowledgment of individual authorship, a complete set returned to each participant for consideration. Participants are asked to rewrite their opinion on the basis of the new knowledge contributed by other experts. The process is repeated until a concensus is reached. The process of written anonymous statements and controlled feedback is based on psychological principles. It is designed to combat many of the distortions that may occur in open communication where high status group members, dominant personalities, majority opinion, and earlier public stands are likely to affect individual judgment and therefore influence group concensus.

In this study the Delphi method was applied to the identification of most successful vocational education programs in community colleges. The number of vocational education programs offered by California community colleges has almost tripled in the last decade. Except for a few licensed programs the expansion of programs has been uncoordinated. This is because of the genuine local base of the community college and a desire to change the junior college image by becoming more comprehensive. Often decisions about the effectiveness or relative success of competing programs must be made without benefit of objective criteria or adequate data, a condition which necessarily restricts the decision space of policy makers and administrators. The problem -- where there were no accepted criteria and little data, and where opinion was likely to be

influenced by administrative position -- seemed to be appropriately matched with the method -- which anonymously pooled the opinion of a cross-section of campus "experts."

But application of the method was not enough. Participating administrators wanted some guarantee that the method was reliable. The need was mother to the invention and a reliability check was built into the experiment by using two similar panels to do the same task. A second check was built into the study by identifying program characteristics that correlate with program success or can be used to differentiate identified successful programs from other programs.

II. Proceedure

A. Delphi Panels

Two comparable Delphi panels were selected by campus research personnel on each of 21 community college campuses in northern California. Each panel contained eleven members chosen to represent each of the following categories:

1. Dean of Instruction, Associate Dean of Instruction, or Dean of Guidance and Admissions
2. Member of College Board of Trustees or Member of Vocational Advisory Committee
3. Vocational Counselor
4. Academic Counselor
5. Instructor in Transfer Curriculum
6. Instructor in Vocational Curriculum
7. Classified Admissions Office Personnel
8. Two Students Enrolled in Vocational Programs
9. Two Students Enrolled in Transfer Programs

On campuses where the organizational structure of the college did not permit identification and selection of these academic types, or where a designated type was unavailable for whatever

reason, analogous types were chosen in order to approximate the ideal panel. Most of the participating colleges were able to meet the panel requirements with little difficulty.

In keeping with the requirement of anonymity, panel members were not informed of other member's identities. Panel members were never assembled as a group.

B. Delphi Rounds

Polling of the Delphi panels took place in three phases or rounds. In the first round, members of each panel on each campus were presented with a comprehensive list of vocational education programs offered on their campus. Instructions were kept to a minimum. Members were asked to "use your own judgment as to what constitutes 'success'" and, on this basis, identify up to five programs "which you consider to be 'most successful'." Panel members were asked not to consult with others and to exercise independent judgment. For each program identified as most successful, panel members were asked to briefly state their reasons for their choice. The first round responses were tallied and programs ordered according to the percentage of panel members identifying them as most successful.

For the second round, a list of ordered programs together with percentages of panelists choosing each program and the reasons for selection was distributed to members of the same panel. The instructions for this round were to read what other panelists had to say about the selected programs and then make a new judgment. This time the panelists were asked to select

three most successful programs rather than five. At the end of round two the results of the two independent panels were compared. Successful programs were defined as those three programs commonly identified by both panels which also had received the greatest percentage of agreement within each panel. Round two was repeated in a few cases where agreement was low.

In a third round the reasons given for identification of successful programs were rated by panel members in terms of their relative importance to program success. These reasons were combined with opinions obtained elsewhere and then incorporated in a questionnaire used to collect data on selected programs for the empirical part of the study.

C. Standard Interviews

Deans of vocational education from each of the participating colleges attended a planning session where they were asked to contribute statements indicating their opinion on what made vocational education programs effective. They were also asked to rate these opinions as to their relative importance to program success. These opinions were combined with the reasons for the selection of successful programs gathered from Delphi round three panelists.

Analysis of the contributed and rated reasons for success was done by a group of five judges knowledgeable in vocational education. Statements reflecting effects or outcomes of successrul programs were separated from statements judged to be

deterministic or causal. For example, the statement "This program is very popular with students on campus" would be judged to be an effect or outcome of a successful program, whereas the statement "Instructors in this program are very good" would be judged to be causal. This pool of opinions and reasons served as the basis for constructing items for a questionnaire used to collect data during a structured interview with first-line administrators of programs identified as successful and other programs not so identified on each campus. Only items that had a reasonable chance of being answered during a structured interview were used.

D. "Other" Vocational Education Programs

"Other" vocational education programs were defined as all programs on the list of local programs from which Delphi panels worked other than the three programs jointly identified as successful. The administrator responsible for research on each campus was asked to select any three programs which met the definition as "other" programs. Although no standardized procedure was recommended, "other" programs on most campuses were chosen by some randomizing process.

III. Analysis of Data

A. Delphi Panel Reliability

Complete data were obtained from two Delphi panels at each of 16 of the 21 participating colleges. In the five colleges that did not complete round two of the Delphi process

problems were encountered which were beyond the control of the college representative who coordinated the Delphi activity.

Data for both Delphi panels for both rounds are presented for the sixteen contributing colleges in Table 1. It is seen that on the first round for College 1 Panel A collectively identified 20 out of 32 programs as successful and Panel B identified 21 out of 32, with 16 successful programs having been jointly identified by both panels. During round two for this college, Panel A and Panel B identified 6 and 8 successful programs respectively, with 5 programs jointly identified by both panels. The probability of such joint idnetification is less than one in one hundred. Generally speaking, in all colleges there was a narrowing down of identified programs from round one to round two. This trend resulted from the controlled feedback of information in the Delphi process. Had there been time, a third Delphi round of feedback and individual identification of successful programs would no doubt have had the effect of reducing the number of identified programs while increasing the number of jointly identified programs.

The probability of joint identification of programs by the independent Delphi panels in eleven colleges listed in Table 1 was less than .05, and the probability of joint identification in six of these colleges was less than .001. It seems clear that we can have a good degree of confidence in the reliability of Delphi panels. It also can be inferred from these results that "successful" programs have a reputation that is sensed or known by the entire spectrum of academic

types who have little trouble reaching a consensus when polled under the proper conditions. A similar conclusion regarding informal group consensus was reached by Wherry and Fryer (7) who found that "buddies" in officer candidate school could identify the capacity for leadership in fellow candidates early in the program, and by Hemphill (4) who found that faculty could identify university departments with reputations for being "best administered." Reputations of successful programs are evidently known by people who function at all levels on a campus. These programs can be identified with a high level of agreement through the use of the Delphi method.

B. Identification of Successful Program Characteristics

1. Correlates of Program Success

Interview schedules were obtained from first-line administrators for 72 vocational education programs. These included three successful and three other programs on each of twelve community college campuses. Completed questionnaires yielded about 100 bits of usable information, 58 of which were analyzed for this paper.

The 58 items were all either dichotomous (no=0, yes=1) or continuously scored and were correlated with the dichotomous variable of a program having been identified as either "other than most successful" (0) or "most successful" (1). Correlations for twenty items significant at the .10 level or better are presented in Table 2, where it is seen that 12 items correlated at better than $p < .05$ and 6 items correlated at

better than $p < .01$. It can be concluded that the programs identified by the Delphi process are indeed different from the programs not identified.

Since the main purpose of this paper is to present results of a study of the reliability and usefulness of the Delphi method in an educational setting, it is not within the paper's scope to elaborate on the meaning of individual item constructs. It will suffice to mention several salient points which may have meaning for vocational programs in community colleges. Successful programs identified in this study are large programs (item 1) which are visible on campus (items 4-8) and enroll females in greater proportion to males (item 2). They are programs which tend to be regulated through state licensing (item 9), screen applicants (item 3), and do not offer remedial courses (item 11). It may be that there is a relationship between screening applicants, licensing, percentage of female students, student visibility, and the uniformed allied health fields. In matters of faculty and faculty supervision it seems reasonable to expect that program size (item 1) and number of instructors (item 12) should be interrelated. However, it should be noted also that in spite of their size successful programs receive closer supervision (items 15-18) and have instructors and an advisory committee that are actively engaged in the occupation (items 10, 13, 14, and 20).

Although the correlation coefficients in Table 2 are statistically significant they are rather small, the largest ones accounting for a modest 20 percent of the variance in

program success. What is perhaps of greater interest in Table 2 is the range of item constructs that correlate with program success. The 20 items are presented in six groups which include the general areas of student characteristics, student visibility, curriculum, faculty, supervision, and advisory committee. The range of item constructs that correlate with program success was further suggested by stepwise multiple regression on the 20 items. While the regression analysis was based on a smaller n than is desirable, and is consequently not reported in detail as a part of this study, seven of the items accounted for about half of the multiple R variance ($R^2 = .529$) due to program success. These seven items distributed themselves over the same six groups or activity areas into which Table 2 is organized. The range of item constructs correlated with program success indicates that the characteristics which differentiate programs are truly multivariate.

2. Differentiation of Programs by Discriminant Analysis

One further check was made on the ability of the Delphi technique to identify truly different programs through the use of discriminant analysis. This check cannot be called a measure of reliability in the classic sense, but it is nevertheless appropriate because it uses "hard" (empirical, subject to independent verification) data to differentiate programs identified through a "soft" (anonymous, opinion-based, concensus oriented) procedure. A basic flaw in the use of linear discriminant analysis here is the small number

of available cases (36 successful, 36 other). Where the number of items entered in the discriminant analysis is large with respect to the number of cases, the results should be viewed with caution. As the number of variables entered becomes smaller (e. g., eight, then six, then three) with respect to the 72 cases, one can have increasing confidence in the application of the algorithm.

As an example, with the above caveat about large numbers of dependent variables, Table 3 presents the results of a discriminant analysis using the twenty correlating items discussed in the previous section entered as dependent variables with "success" and "other" entered as the independent variables. It is seen that 30 of 36 programs identified as successful by the Delphi panels were "correctly" classified by the discriminant analysis and 6 were "mis-classified" as other, whereas 32 of the programs not identified by the Delphi panels (the other programs) were "correctly" classified by discriminant analysis with 4 being "mis-classified" as successful. If confidence could be had in this application of discriminant analysis (based on 20 items and 72 cases) it would be possible to say that the Delphi technique and the discriminant analysis were in agreement on 83 percent of the successful programs and on 89 percent of the other programs.

The results of several discriminant analyses using varying numbers of items taken in groups from the questionnaire are presented in Table 4. The groups of items were clustered together on an a priori basis before being entered into the

discriminant analysis with no attempt having been made to screen out "weak" items or to factor and scale correlated items. As mentioned above, this analysis was not undertaken in order to study the qualities of success. The objective was to test the differentiating ability of the Delphi technique against the differentiating ability of a statistical technique which is suitable under the circumstances with this kind of data.

The data presented in the first item group in Table 4 are the same data given in Table 3 for illustrative purposes. Other groups of items contained from three to nine items with the exception of one group that contained 21 items. The results in general follow the results of the correlations given in Table 2. Groups of items which contained one or more of the significantly correlated items from Table 2 tended to discriminate at statistically significant levels. The important point to be made from Table 4 is that, depending on the set of items chosen, from 50 to 97 percent of the programs were classified as either successful or other by both the Delphi and the discriminant analysis techniques. Fifty percent "correct" classification is, of course, what might be obtained by random assignment. In Table 4 the median percentage of "correct" classifications was 72 percent with none falling below 50 percent. For all the analyses in Table 4 considered together, seven out of ten programs were similarly classified by both techniques. It seems likely that a refinement of items through either factor analysis or some other clustering method

and application of an appropriate scaling technique will increase the incidence of joint classification between the Delphi method and discriminant analysis.

With discriminant analysis we have used a statistical technique to classify programs into two groups on the basis of verifiable characteristics. The two groups are then tabled and contrasted with the Delphi classification of programs as in Table 4 and joint classification and mis-classification noted. It is not possible to say which technique is responsible for the mis-classification of programs. The large number of programs identically classified by both techniques is offered as evidence of the validity of the Delphi technique when used in this type of situcation. For example, in the case of the three items describing prerequisite and remedial provisions (bottom line of Table 4), 35 out of 36 programs (97 percent) were jointly identified as successful by both techniques, while 23 out of 36 programs (64 percent) were jointly identified as other. Considering the unrefined nature of the items and the loose definition of "other" programs, this is a truly remarkable amount of agreement between two manifestly dissimilar techniques applied to the diverse vocational education programs offered by community colleges. These results indicate that generalization with regard to characteristics of successful programs is quite possible, and therefore, further study should prove fruitful.

IV. Discussion

The primary importance of this study is in the application of a technique for reaching group concensus to a sensitive area of educational administration. The planning stage of the experiment brought together deans of vocational education and administrators of institutional research from more than twenty community colleges. Participation in the planning phase exposed the deans to a collective research effort, made them less anxious about research, and encouraged them to consider tackling a problem fraught with administrative and political difficulty -- the identification of successful programs according to some intuitive procedure. Aside from its didactic value, inclusion of the deans also served to gain their support and thus make possible the study. Execution of the experiment confirmed the usefulness of the Delphi method when applied to an appropriate educational problem, one in which anonymity must be guaranteed and one which, because of a lack of precedent and a lack of management information, is approachable by the application of available collective expertise.

On a methodological level the experiment validated the Delphi method two ways. The first was through the use of two Delphi panels on each campus, one to be used as a reliability check against the other. The second was by collecting data which was successfully used to statistically differentiate programs already differentiated by the Delphi method, thus reinforcing the reliability of the method while simultaneously confirming its validity under these circumstances.

On an empirical level the study identified the multivariate nature of success in vocational education programs. Twenty items with potential for predicting program success were identified. Of particular interest is the fact that the 20 variables distrubute themselves among five major topical groups: Student; curriculum; faculty; management; and "trusteeship."

The process of forming value judgments about programs through Delphi panels and later statistically validating these judgments through the use of program profiles based on hard data is seen as a useful procedure for evaluating programs in situations where objective criteria are not available. Futher application of the Delphi technique is limited only by administrative imagination.

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TABLE 1. Reliability of Successful Program Identification by Comparable Delphi Panels

College	Number of Voc-Ed Programs Offered	Round One			Round Two			Probability Of Joint Identification Less Than[a]
		Panel A	Panel B	In Common	Panel A	Panel B	In Common	
1	32	20	21	16	6	8	5	.01
2	17	11	11	7	6	5	4	.10
3	101	27	27	12	10	11	5	.001
4	17	11	13	10	7	6	4	NS
5	17	15	10	8	8	6	5	.10
6	24	14	12	12	8	7	4	NS
7	38	16	16	14	8	9	6	.001
8	24	16	17	14	7	6	5	.10
9	25	13	15	11	9	10	5	NS
10	31	17	18	12	9	10	8	.001
11	32	12	13	8	10	10	8	.001
12	22	13	11	11	8	8	8	.001
13	30	18	18	16	11	9	6	.05
14	13	10	12	9	7	5	5	.05
15	26	19	16	14	11	9	7	.05
16	42	18	14	10	8	6	5	.001

[a]One college, shown as NS here, was administered a third round under the Delphi technique with the result that commonly identified programs reached $p < .001$.

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TABLE 2. Correlations for Selected Items With Success of Program

Item Cluster Description		Item Description[a]	Correlation Coefficient
Student Items	1.	Number of students in program	.34 B[b]
	2.	Percent male enrollment	−.35 B
	3.	Are prospective students interviewed prior to admission in the program?	.28 C
Student Visibility Items	4.	Is the student enrolled in this program recognized as a member of an occupational training group by wearing a uniform?	.44 A
	5.	Does the student take most of his/her course work at the same general location?	.21 D
	6.	Do students generally eat lunch together with other students in the same program?	.20 D
	7.	Does the student have several classes where he works closely together with the same students in a lab or work experience situation?	.21 D
	8.	Does the student belong to a club with other students training for this occupation?	.25 C
Course Items	9.	Does this program have a state licensing or certification procedure?	.45 A
	10.	Are off-campus facilities regularly used for training of students in this specialty?	.22 D
	11.	Are specific remedial provisions available to entering students?	−.20 D
Instructor Items	12.	Number of instructors in program.	.36 B
	13.	Number of instructors with full-time field experience in the last two years.	.33 B
	14.	Number of instructors with recent summer field experience.	.20 D
Instructor Supervision Items	15.	Are classroom visitations made regularly by supervisory personnel?	.21 D
	16.	Are tenured teachers visited?	.21 D
	17.	Are non-tenured teachers visited?	.26 C
Advisory Committee Items	18.	Did the advisory committee for this course meet during the last school year?	.22 C
	19.	Number of members on the advisory committee for this occupation.	.27 C
	20.	Number of advisory committee members currently employed in or are supervisors of personnel in this occupational specialization.	.24 C

[a] These item descriptions are paraphrases.

[b] The letters after the correlation coefficients indicate levels of statistical significance with probabilities of A < .001, B < .01, C < .05, and D < .10.

TABLE 3. Comparison of Program Classifications Made by the Delphi Technique and by Linear Discriminant Analysis Using Twenty Items in Table 2.

		Delphi Technique		
		Success	Other	Percent Agreement
Discriminant Analysis Technique	Success	30	6	83%
	Other	4	32	89%

$F(20, 51) = 3.76 \quad p < .01$

TABLE 4. Summary Table for Comparison of Delphi Technique with Discriminant Analysis for the Classification of Programs

Item Group	"Success" or "Other"	Percent in Agreement	F-ratio	df	p less than
Twenty items with significant correlations	S O	83 89	3.76	20,51	.01
Five items describing the program	S O	72 78	5.54	5,66	.01
Six items describing the instructional staff	S O	67 67	2.76	6,65	.05
Nine items describing use of equipment & facilities	S O	69 72	1.01	9,62	NS
Three items describing program management	S O	75 75	2.08	3,68	NS
Eight items describing curriculum & scheduling	S O	72 72	1.97	8,63	NS
Twenty-one items describing recruitment & placement	S O	92 81	1.60	21,50	.10
Six items describing the Advisory Committee	S O	58 69	1.72	6,65	NS
Four items describing recruiting visits to high schools	S O	72 67	.97	4,67	NS
Six items describing placement services	S O	61 50	.24	3,65	NS
Eight items describing visibility of students	S O	83 81	3.72	8,63	.01
Three items describing prerequisites & remedial provisions	S O	97 64	3.86	3,68	.05